

RESEARCH PROBLEM STATEMENT #TS-504

I – Problem Title

Quantifying the Performance of Countermeasures for Collision Concentrations Related to Ramp/Freeway Mainline Intersections (2004SAF.4)

II – Research Problem Statement

Nearly two-thirds of all fatal and injury collisions on the CA State Highway System (SHS) occur on freeways, yet there are relatively few strategies or countermeasures in the Traffic Safety Program “toolbox” for traffic investigators to consider applying at problem locations. To be more specific: each year in California, freeway entrance and connector ramps deliver more than 10 million drivers to thousands of conflict points, defined as the location where a ramp merges into the freeway mainline. Yet, there are currently no strategies available in the Safety Program toolbox to respond to collision concentrations related to the merge and diverge operations that occur at or near the intersection of ramps and the freeway mainline.

III – Objective

In order to provide some basic tools with which traffic investigators can respond to safety “problems” that are attributed to the intersection of ramps with the freeway mainline, it has become necessary to establish collision reduction “factors” for one or a number of improvement strategies. Such factors - if supported by “before-after” collision analysis - could be plugged into the Caltrans Safety Index methodology in order to facilitate decision-making regarding the cost-effectiveness of safety improvement proposals, thereby expediting the process by which safety improvements are implemented. In addition, such an effort will help to mainstream such strategies, and thereby overcome the reluctance of traffic investigators to recommend or pursue improvement strategies that are not “in the tool box.”

Some - but not all - of the following improvement strategies should be researched:

1) For diverge locations - Exit ramp modifications designed to provide:

- * a longer deceleration “lane” beyond the exit gore and prior to the first horizontal ramp curve;
- * a deceleration and storage area parallel to the mainline freeway in order to accommodate the speed differential that occurs when exit ramp geometry and/or operation requires deceleration prior to the exit gore.

2) For merge locations - Entrance ramp modifications designed to provide:

- * a longer “acceleration lane” (see Chapter 500 of the HDM for the limits of this portion of standard entrance ramps) (NOTE: this is NOT an auxiliary lane!);
- * a parallel acceleration and merge lane to minimize the speed differential between ramp and mainline traffic, and to increase the number of opportunities for entering traffic to safely merge into the outside mainline traffic lane - the lane which is occupied by a higher percentage of trucks than any other lane

IV – Background

Freeway / ramp Intersections are conflict points that perform poorly in terms of collision statistics when the geometric design of the merge / diverge area fails to provide an adequate:

- 1) acceleration distance for ramp vehicles, thereby causing a higher than optimum speed differential between conflicting vehicles
- 2) opportunity for entering traffic to merge safely with mainline traffic; this is directly related to the distance available for identification and selection of gaps in mainline traffic
- 3) deceleration length or distance that is needed to allow exiting traffic to reach a speed that is safe for downstream ramp geometry.

It should be noted that the problems described above will occur only when freeway mainline speeds are not affected by congestion. In other words, the potential for collisions increases as the speed differential increases. This is obvious at conventional highway intersections where stopped or slow-moving traffic can be in conflict with moderate or high speed traffic.

V – Statement of Urgency and Benefits

Since entrance and exit ramps are the only access / conflict points along freeways, it might be expected that these locations are responsible for a significant percentage of freeway collisions. Therefore, research that can facilitate the implementation of safety improvements at these locations can have a significant impact on the reduction of freeway collisions.

VI –Related Research

If research has already been performed by other transportation agencies, then it may be valuable to build upon it, and even reduce the scope of this effort to avoid redundant work.

VII – Deployment Potential

It appears that the outcome or work products can be deployed throughout the state, or wherever freeways exist.